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Sweet Potatoes: Culture and Uses.

BY

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., September 7, 1900.

SIR: I have the honor to transmit herewith copy for a revised edition of Farmers' Bulletin No. 26, Sweet Potatoes: Culture and Uses, and to recommend its publication. The wearing out of the plates from which former editions were printed has given an opportunity to revise and perfect the text of this bulletin, but no important changes have been made, and no new matter has been included.

Very respectfully,

A. C. TRUE,
Director.

Hon. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

ILLUSTRATIONS.

SWEET POTATOES: CULTURE AND USES.

INTRODUCTION.

The sweet potato (*Ipomœa batatas*) belongs to the morning-glory family (*Convolvulaceæ*). The enlarged root is prized as a vegetable, while the long vines are not generally utilized, although of value as a food for live stock.

Authorities have not been able to agree whether the sweet potato owes its origin to America or to the East Indies. In the warmer regions of both the Eastern and the Western continents it is extensively cultivated.

According to the census of 1890, the United States produces annually in round numbers 44,000,000 bushels of sweet potatoes. The eighteen States growing the greatest quantities are as follows:

	Bushels.		Bushels.
North Carolina	5,665,391	Louisiana	1,912,080
Georgia	5,616,317	Arkansas	1,822,960
Texas	5,505,452	Florida	1,749,679
Alabama	4,339,170	Kentucky	904,125
Mississippi	3,207,125	Missouri	561,551
South Carolina	3,061,040	Kansas	533,846
Virginia	2,816,041	Illinois	451,125
New Jersey	2,254,344	Maryland	408,549
Tennessee	1,973,625	Delaware	202,914

New Jersey is the most northerly State in which sweet potatoes are extensively cultivated. However, good crops have been matured at Geneva, N. Y., and Lincoln, Nebr., on the grounds of the agricultural experiment stations. In gardens still farther north the sweet potato has been cultivated. Maine, for example, is credited in the last census with 267 bushels.

PROPAGATION BY SETS.

The sweet potato is most commonly propagated by means of the buds or shoots from the roots. The roots are planted in open beds, cold frames, or hotbeds, and the buds or shoots which develop are removed and transplanted in the field. In some localities the cuttings or sections from the vines secured by the above method of propagation are transplanted, and the plants thus obtained produce the bulk of the crop. It is possible to propagate by planting true seed or by planting portions of the root, as with Irish potatoes. The sweet potato rarely matures seed in the United States, although true seeds have been produced in greenhouses. The sprouts or shoots from the parent root have different local names. In this bulletin they will be referred to as sets.

THE PLANT BED.

To secure the sets for transplanting, the eyes or buds on the sweet potato must be sprouted. For this purpose considerable heat is required, and germination takes place in especially prepared open beds, in cold frames, or in hotbeds, the kind of bed used depending on the climate and on the degree of forcing desired. For an early crop, bottom heat is desirable. This is provided either by the fermentation of manure or by flue heat from a small furnace, the former method being most frequently employed. The latter method, however, permits of a more complete regulation of the amount of heat, and has other advantages which recommend it to those who cultivate the sweet potato on a large scale for market.

For the sweet-potato-plant bed select a location somewhat protected on the north side. Build an ordinary plank cold frame 6 feet wide and of any length desired, facing toward the south and having its north wall several inches higher than its south wall. On the outside bank dirt against the frame and protect the bed against drainage water by a shallow drain around the outside. Protect the bed against moles by means of a drain or by planking the frame below the surface of the ground.

Within the frame remove the earth to a depth of 2 to 12 inches; spread a thin layer of leaves or litter on the bottom of this excavation, to assist in draining the bed and to retain the heat. Then on this litter place a layer of manure 2 to 12 inches thick, the thickness of the layer depending on the amount of heat required. Level and pack the manure and on it place a layer of sand or soil $1\frac{1}{2}$ to 3 inches thick. On this place the sweet potatoes in a horizontal position, not touching each other. If large roots are used they may be split lengthwise, placing the cut surface downward. Cover with sand, soil, or fine woods earth until the upper side of the sweet potato is covered at least 1 inch deep, or better 2 to 3 inches deep.

After the sweet potatoes are covered the upper surface of the earth within the frame will be either on a level with the ground outside or 1 to 6 inches above the level of the surrounding soil, according to the depth of excavation made in starting the bed. A bed with its surface considerably higher than the surrounding soil is better drained, but is liable to suffer from drought or to require more watering than a lower bed.

The amount of manure required depends on climate, season, character of manure, and to a less degree on some other factors. Experienced growers in localities where early sweet potatoes are grown for market endeavor to use such an amount of manure as will keep the soil around the bedded roots at about 75° to 80° F.; during the first few days after bedding, the soil is sometimes allowed to warm up to 85° or 90°. In the Gulf States the usual depth of manure is 2 to 5 inches, while in New Jersey a depth of 12 inches is not uncommon. The manure should be

rather coarse horse manure which has not been repeatedly heated; when applied it should be moistened, and then leveled and packed. In the Southern States a layer of 2 to 4 inches of thoroughly moistened cotton seed is sometimes substituted for manure. In some localities in the South it is customary to cover the bedded sweet potatoes with 3 or 4 inches of soil, and when the sprouts are nearly ready to come up, to rake off 1 or 2 inches of the covering. This serves as a cultivation and destroys weeds if any are present. If the potatoes are covered shallow, a thin covering of earth may be added just as the sprouts begin to appear.

The movable cover of the bed may be either of litter, boards, cloth, or glass, depending on climate, season, and degree of forcing desired. Glass is most satisfactory when an early crop is desired, but its expense is against its use in many cases, and cloth oiled with linseed oil is substituted. The labor involved in moving litter of any kind, as pine needles, straw, marsh hay, etc., to admit the sun during the warmer part of the day is considerable, and in most cases a cloth cover is more satisfactory. After the sprouts appear above ground they should be toughened by a process of gradual exposure to the outside air, raising or removing the cover in suitable weather. The bed should be kept moist, but not wet. If necessary the bed should be watered before and after the appearance of the sets, and should be protected against heavy and cold rains.

If the heat from the fermenting manure becomes excessive it may be reduced by removing the cover of the plant bed, by making small holes in the soil down to the layer of manure, or by the application of water.

The preparation of a plant bed in which artificial heat is used is thus described by a sweet-potato grower in New Jersey:

Select a location where sufficient rise can be had, say 1 foot in 20. Build a furnace of brick to burn coal or wood; if you wish to use wood build not less than 2 by 2 by 5 feet. The top of the furnace should be depressed about 3 feet below the bed and covered with soil so as to avoid danger of fire. Take 3 rows of 5 or 6 inch tile for flues and run them about three-fourths the length of bed; here we have a hot-air space about 1 foot deep running all under the bed. Cover this space with boards and put a board chimney at the upper end, with damper to regulate draft. Keep damper well closed to hold the heat. Beds should be about 12 feet wide and from 48 to 100 feet long.

On the plank floor of the bed is spread a layer of about 5 inches of sand or soil. On this the potatoes are placed and then covered with earth as in a bed warmed by manure. The flues may be made of brick instead of tile. As an extra precaution against fire a coat of asbestus paint may be applied to the woodwork of the bed. The bottom of the bed may be level, the slope of the ground giving the necessary grade to the flue, and the hollow space between the bottom of the bed and the ground should be closely boarded in. By excavating, the bed may be brought down to the level of the ground around.

Another successful sweet-potato grower has a sweet-potato bed with furnace and brick flues, arranged as shown in the diagram (fig. 1). The flues have a slight grade and terminate in a chimney directly over the furnace. The 4-inch space between the double wooden walls which inclose the hot-air space below the bed is filled with sawdust. The 2 by 4-inch studs of this wall, which support the bed, are 3 feet long. Earth is heaped against the walls on the outside.

PERIOD OF GROWTH OF SETS.

The sweet potatoes intended for seed purposes should be bedded 5 or 6 weeks before the date on which it is expected to transplant the first lot of sets.

The sets are large enough for transplanting when their length above ground is 3 to 5 inches if they are sufficiently tough to admit of handling. If they are ready before a safe date for setting in the field or before the ground is ready, Oemler recommends that they be detached from the parent roots, and in a protected situation "heeled in," like strawberry plants awaiting transplanting. Their early removal

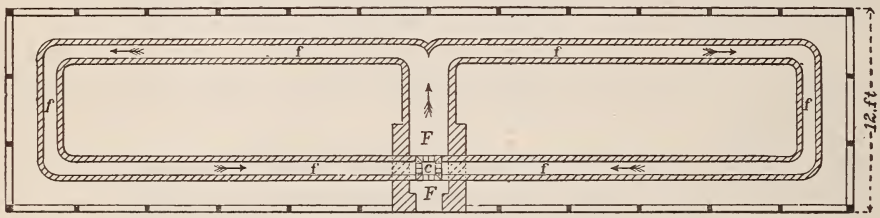

FIG. 1.—Sweet-potato bed, with furnace and flues.

F, furnace; *fff*, flue; *c*, chimney. The arrows indicate the direction of the hot-air current.

allows younger sprouts an opportunity for growth. At least three crops of sets—three "drawings"—may be obtained, although growers desiring an early crop may be able to utilize only one or two of these drawings. The sweet-potato plant is very susceptible to cold, and the sets can not be transplanted with safety until danger of frost is past.

Sweet-potato growers report the following dates as the earliest at which they consider it safe to set out sweet-potato plants for an early crop: Near Jacksonville, Fla., March 20 to April 1; South Carolina, Georgia, Alabama, Mississippi, and Arkansas, April 1 to 25, and the southern part of New Jersey, May 1 to 15. For the main crop the latter part of May is preferred in New Jersey, and May and June in the Gulf States. At Knoxville, Tenn., at an altitude of about 900 feet, the Experiment Station obtained larger yields by transplanting May 4 than at earlier or later dates. Very early planting is desirable only where an extra-early crop can be marketed at a high price. To get the healthiest growth of plants, large yields, and roots with the best-keeping qualities, transplanting should be postponed until the soil becomes thoroughly warm.

Ninety days after transplanting is generally regarded as the shortest period required for growth before the early varieties of sweet potatoes are ready to be dug for the family table or for the market, though some growers report 75 days, and a few even 60 days, as the minimum period between transplanting and early harvesting. Such rapid development, however, is to be expected only in peculiarly favorable seasons, with late transplanting, and for early varieties.

AMOUNT AND CHARACTER OF SWEET POTATOES USED FOR SEED.

Since sweet potatoes of every size, from that of a cigar upward, are bedded, the amount of seed potatoes required to fill a plant bed of given dimension or to furnish sets for an acre varies within certain wide limits. The larger the potatoes the smaller the amount of plant-bed space necessary to accommodate a bushel, the smaller the number of sets per bushel of bedded roots, and the greater the number of bushels of seed potatoes required to furnish sets for an acre.

The space in the plant bed covered by 1 bushel of large sweet potatoes is estimated at 9 to 17 square feet; by 1 bushel of medium-sized roots, 17 to 25 square feet; by 1 bushel of small potatoes, 21 to 32 square feet. These limits are for roots bedded with customary thickness, but they lack exactness because there is no definite standard for determining whether a sweet potato is large, small, or medium in size.

The quantity of seed potatoes required by an acre varies even more widely than does that for a given plant bed, by reason of the fact that 3 or more crops of sets are produced. Moreover, the number of plants per acre varies in different localities from 5,000 to 10,000. Hence the following figures are presented only as rather rough estimates: An experienced New Jersey truck farmer reports that he is able to utilize, during the entire planting season (which is comparatively short in New Jersey), 2,500 sets from every bushel of small seed potatoes bedded. From two other localities we have an estimated yield of 2,000 sets obtained at the first drawing from a bushel of sweet potatoes classed as medium in size, a result which seems to be too favorable to be expected under ordinary circumstances. Experience appears to justify the following approximate estimates of the amounts of seed sweet potatoes required to furnish sets (not cuttings) for an acre: When sets are drawn repeatedly, small potatoes, 1½ to 2 bushels; medium-sized potatoes, 2 to 4 bushels; large potatoes, 4 to 10 bushels. To plant an acre with sets obtained at first drawing, these quantities should be doubled.

In localities where the chief dependence is on vine cuttings from early plants, much smaller amounts of seed will suffice. A Texas farmer obtained from 1 acre of plants propagated by sets sufficient vine cuttings to supply 2 or more acres; another in Florida cut from 1 acre vines enough to set out 4 acres. This necessitates such close pruning of the growing vines as probably to affect the yield on the area pruned.

It appears that variety as well as size is a factor in determining the quantity of seed potatoes, for one grower rates Southern Queen 50 per cent higher than Yellow Nansemond in reproductive power, and another considers it necessary to use only one-third as much seed for White West India as for Providence.

At the Alabama College Experiment Station in 1891 the gain in yield from using sets from large rather than small sweet potatoes was considerable. At the Georgia Station large and small potatoes gave practically identical yields.

Whether large or small potatoes should be selected for seed is a mooted question among farmers, and the above-mentioned experiments are not decisive. Small potatoes are most used, chiefly, perhaps, on account of their unfitness for other purposes. It is much in their favor that a bushel affords a relatively large number of sets. Small potatoes, about an inch in diameter, grown from vine cuttings, are preferred on the Eastern Shore of Virginia, because they keep better and are believed to give hardier sprouts than sweet potatoes grown from sets.

There are those who assert that if small and unshapely roots are planted the quantity and quality of the resulting crop will be injuriously affected. For many cultivated plants with true seeds it has been shown that large and perfect seeds yield better returns than small and deformed seeds. The sweet-potato root, however, is not a seed; nor is it in the same class with the Irish potato tuber, with which medium to large have generally given better yields than small potatoes. The Irish potato continues for a long time as a storehouse of food for the growing plant; hence the larger the storehouse the more vigorous the growth of the plant; the sweet potato set, however, is early detached from this source of nourishment and in the field receives no parental aid.

While admitting the need of more information in regard to the best size of seed sweet potatoes, we think it advisable to plant short, well-formed roots of medium or small size and of perfect soundness.

PROPAGATION BY VINE CUTTINGS.

Propagation of sweet potatoes by means of vine cuttings is of great economic importance, this method being in general use in the Gulf States and in other States with a similar climate. Even as far north as the counties of Virginia lying along the Chesapeake Bay small roots to be used as seed potatoes in the following spring are obtained by setting out vine cuttings.

The data furnished by growers seem to indicate that as a general rule vine cuttings can be set out with advantage until within 90 to 105 days before the average date at which the first autumn frost occurs in a given locality.

Experiments comparing the yield from sets and from vine cuttings were conducted at the Alabama Agricultural College in 1884 and in

1886. The results taken as a whole were slightly in favor of vine cuttings. At the Louisiana Station sets gave larger yields than vine cuttings. The crop from plants propagated by vines generally contains a larger percentage of small potatoes, a natural result of the shorter time usually allowed for this crop to mature. The use of cuttings instead of sets effects a great economy in seed potatoes.

At the Louisiana Experiment Station sweet-potato vines were pruned weekly to a length of 2 feet. The pruned vines yielded considerably less than the vines that were not pruned, and this in a year when growth was very vigorous. Pruning resulted in increasing the percentage of small potatoes, a condition which should be avoided.

SOIL—CHARACTER AND PREPARATION.

The sweet potato makes its best growth on a warm, sandy, well-drained, or even dry soil. Light loams are also suitable. Recently cleared ground, if susceptible of thorough preparation, is suitable for the sweet potato, provided it is entirely free from shade. For cold, compact clay this plant seems to have an aversion. On Southern farms the sweet potato is too often relegated to the poorest fields, under the scarcely tenable, but widely current, opinion that a rich soil or liberal manuring makes luxuriant vines at the expense of the roots. The soil should be of such texture and color that it will not adhere to and stain the roots. Clay adheres to the roots and injures their appearance; sand is easily rubbed off in handling.

Weeds are troublesome and expensive visitors in the sweet-potato field, and hence the crop should follow a hoed crop. An exception perhaps to this rule is the growth of crimson clover to be plowed under in April or May as a green manure for the sweet-potato plant.

To secure the short, well-shaped potatoes, which the large markets prefer, it is customary in truck-farming regions with sandy soil to plow very shallow, only 3 or 4 inches deep. Stiffer, less permeable soils are plowed deeper. It can scarcely be doubted that deep plowing on all soils, except perhaps on those which are very light and loose, largely increases the yield of sweet potatoes, whatever its effect on the shape of the roots. Hence those who do not grow sweet potatoes for shipment can advantageously plow deeper for this crop than can truck farmers. After thorough preparation with plow, harrow, and roller shallow ridges are formed and on their flattened tops the sets or vines are transplanted.

TRANSPLANTING.

Most growers prefer to set the plants in moist, recently prepared soil. Others make a slight ridge a few weeks in advance of transplanting, and just before putting out the plants plow fresh dirt to this ridge. Only experience in each locality can determine whether the ridges for

sweet potatoes should be low or high. As a general rule crops grown on low ridges give larger yields, provided the season of growth is long and the land well drained and warm; high ridges are warmer and more subject to drought, but are sometimes advantageous on cold, undrained soil and for an early crop. At the Georgia Experiment Station in 1891, 3 varieties averaged 255 bushels per acre when grown on ridges, and 277 bushels when cultivated level, a difference of 22 bushels per acre in favor of flat cultivation. On the other hand, at Baton Rouge, La., the Louisiana Experiment Station found that high ridges gave larger yields than low ridges or level cultivation.

By planting in checks instead of in drills and by plowing in two directions hand labor is saved in cultivation. The hills may be made entirely by the plow, or by both plow and hoe. Opinions differ as to whether planting in drills or in hills is more profitable. In drills a greater number of plants can be grown, and somewhat larger yields are generally obtained than by checking; the advantage of checking consists in the saving of labor.

LABOR-SAVING TRANSPLANTERS.

The sprouts or sets when 3 to 5 inches long above ground are carefully removed from the bed without dislocating the parent potato. The sets are dropped on top of the ridges and transplanted with the fingers, with a dibble or paddle, or with a pair of homemade wooden tongs, constructed of two pieces of laths or small strips 3 feet long, separated by a block nailed between them at one end; the strips at their free ends are about 1 inch apart and are easily pressed together by the grasp of the hand in seizing the set. A rod carried in the other hand is used to press the soil around the plant. This device, largely used in New Jersey and Delaware, relieves the planter from stooping and hastens the work. A transplanter worked by 2 horses and 3 men was favorably reported in Bulletin 21 of the Florida Station. It sets and waters from 3 to 6 acres per day of tobacco, tomato, or sweet-potato sets. It is not arranged for setting vine cuttings. The chief barrier to its more extensive use is its cost, said to be about $75. For setting out vines a stick with fork or concave surface at the lower end and as long as a walking stick is in general use.

If the ground is dry at the time of transplanting it may be necessary to water the sets or vines as they are placed in position, immediately afterwards drawing dry dirt up to the plant to hinder evaporation. The practice of setting out sweet potatoes while the ground is very wet is to be condemned, especially if the soil contains much clay. Dipping the lower part of the set in a paste made of soil and cow manure is sometimes practiced when the sets are to be placed in rather dry soil without watering. The afternoon is better than the morning for transplanting. The missing hills should be replanted as soon as possible.

In Kansas the sweet-potato plant has been subjected to irrigation, with satisfactory results, both as to quantity and quality of crop.

DISTANCE BETWEEN PLANTS.

In an experiment at Baton Rouge, La., sweet-potato plants were placed 8, 12, 15, and 18 inches apart in rows spaced 3½ feet. The average yields of merchantable roots for 3 years were as follows: At 8 inches apart, 252 bushels per acre; 12 inches, 258 bushels; 15 inches, 275 bushels; 18 inches, 281 bushels. At the Georgia Experiment Station a distance of 2 feet between plants in rows 3½ or 4 feet apart afforded the largest yield in certain years, although in 1893 a distance of 18 inches gave best results.

When sweet-potato plants are grown in checks a distance of 30 by 30 inches is the least that is convenient, and this affords about 7,000 hills per acre.

CULTIVATION.

Sufficient cultivation should be given to the growing plants to keep the surface soil loose and free from weeds. Two to four plowings with the cultivator and one or two hoeings should suffice. After the vines begin to run plowing can be done only by moving the vines with a pronged hoe or hook in advance of the plow, or better by using a cheap vine-lifting attachment on the cultivator. Dirt should never be thrown on the vines, and all cultivation should be shallow.

Many growers are careful to prevent the vines taking root at the joints. Peter Henderson has stated that in the northern part of the sweet-potato region if the vines are allowed to root freely the potatoes will be small and nearly worthless. However, at the Louisiana Station at Baton Rouge sweet-potato vines undisturbed yielded 352 bushels of marketable sweet potatoes per acre, while vines lifted twice per week yielded only 226 bushels.

Sweet-potato growers in a number of States were asked whether their experience justified the expense of moving the vines after the last cultivation. About 70 per cent of them answered in the negative. The gist of the matter seems to be this: Moving the vines after cultivation ceases costs too much labor to be advantageous, except possibly when cultivation is discontinued early or when, on rich, moist soil, a heavy rain falls within about two weeks after the last cultivation.

MANURING.

Before noting the actual results secured in fertilizer experiments let us consider the amount of fertilizing material contained in the roots and vines of an acre of sweet potatoes. In a highly fertilized field near Washington, D. C., the writer weighed the sweet-potato roots and vines growing on a large plat. The roots averaged 17,898 pounds

per acre, or about 350 bushels. The vines on this plat were luxuriant, and when cut, October 1, 1894, completely covered the ground. The yield of fresh vines was 10,374 pounds per acre.

According to analyses made at the New Jersey Experiment Station fresh sweet-potato roots contained 0.23 per cent of nitrogen, 0.10 of phosphoric acid, and 0.50 of potash.

The fresh vines referred to above were analyzed in the Division of Chemistry of this Department, with the follow result: Water, 83.06 per cent; nitrogen, 0.42; phosphoric acid, 0.07; potash, 0.73; lime, 0.44; total ash, 2.45.

If we assume 10,000 pounds of roots (equivalent to 185 bushels) and 8,000 pounds of vines per acre as a fair yield, we have the following figures showing the amounts of fertilizing ingredients contained in roots and vines of a crop of this size:

Fertilizing ingredients in roots and vines of sweet potatoes.

	In roots.	In vines.	In roots and vines.
	Pounds.	*Pounds.*	*Pounds.*
Nitrogen	23	34	57
Phosphoric acid	10	6	16
Potash	50	58	108

Much more potash than nitrogen and much more nitrogen than phosphoric acid is appropriated by the sweet potato, and this is true whether we look only at the roots, the part always removed from the soil, or at the entire growth of roots and vines.

Assuming that sweet-potato vines are left on the land and that wheat straw is finally returned to the soil from which it came, we find that 185 bushels of sweet-potato roots remove practically as much nitrogen and phosphoric acid and more than seven times as much potash as 20 bushels of wheat.

The amounts of nitrogen, available phosphoric acid, and potash contained in a sweet-potato crop of 185 bushels of roots and 8,000 pounds of vines would be supplied by the following amounts of commercial fertilizers:

Amounts of different fertilizers needed to supply fertilizing ingredients in a crop of sweet potatoes, including vines.

57 pounds nitrogen in—	16 pounds[1] available phosphoric acid in—	108 pounds potash in—
363 pounds nitrate of soda, or 542 pounds dried blood, or 803 pounds cotton-seed meal, or 11,600 pounds barnyard manure.	96 pounds dissolved boneblack, or 138 pounds superphosphate.[2]	210 pounds muriate of potash, or 320 pounds sulphate of potash, or 793 pounds kainit, or 475 pounds cotton-hull ashes.

[1] According to an analysis made at the Texas Experiment Station about 25 pounds of phosphoric acid, i. e., 150 pounds of dissolved bone or 215 pounds superphosphate, is required.

[2] Called also acid phosphate and dissolved South Carolina rock, and containing 11.6 per cent available phosphoric acid.

It may be considered sufficient in some cases to apply only the quantity of fertilizing material that is removed by the roots of the sweet potato, the vines being left on the ground. Ten thousand pounds of sweet-potato roots contain fertilizing ingredients equal to those found in the kinds and amounts of fertilizers given below:

Amounts of different fertilizers needed to supply the fertilizing ingredients of 10,000 pounds of sweet potatoes.

23 pounds nitrogen in—	10 pounds available phosphoric acid in—	50 pounds potash in—
146 pounds nitrate of soda, or 218 pounds dried blood,[1] or 324 pounds cotton-seed meal,[2] or 4,694 pounds barnyard manure.[3]	60 pounds dissolved boneblack, or 86 pounds superphosphate.	97 pounds muriate of potash, or 150 pounds sulphate of potash, or 367 pounds kainit, or 220 pounds cotton-hull ashes.[4]

[1] Containing also about 4 pounds of phosphoric acid.
[2] Containing also about 10 pounds of phosphoric acid and 6 pounds of potash.
[3] Containing also about 15 pounds of phosphoric acid and 20 pounds of potash.
[4] Containing also about 17 pounds of available phosphoric acid.

These figures are not given as representing the exact amounts of fertilizing materials which should be applied to sweet potatoes, for the plant draws a part of its food from the soil, and soils vary widely in fertility, one soil being especially poor in potash, another in nitrogen, and so on. On the other hand, a part of the fertilizer applied to a particular crop is completely lost in the drainage water or becomes unavailable in the soil. The only way to be sure of the amount of fertilizer which can be advantageously used on a given field is to experiment.

Although not absolute guides in manuring, the results of analyses of the sweet potato are of value, in that they emphasize the special need of potash either in the soil or in the fertilizer for this crop. Another reason for using potash fertilizers is the fact that sandy soils, which are preferred for sweet potatoes, are frequently deficient in potash.

In practice it is customary and apparently advantageous to use more phosphoric acid than the crop contains, since phosphates, when added to the soil, largely enter into forms in which they are not immediately available to plants.

The opinion is prevalent that nitrogenous fertilizers stimulate the growth of sweet-potato vines at the expense of the roots. A careful examination of all the experiments on this crop published by the experiment stations leads to the conclusion that nitrogen when applied in connection with phosphoric acid and potash increases the crop of roots in most instances. From results secured by the New Jersey and Louisiana Experiment Stations, it appears that heavy applications of nitrogenous fertilizers under some conditions injure the quality of the crop. The sweet-potato plant must have nitrogen; it has, however, a long growing season extending through all the hot months, when nitrification is active in soils filled with vegetable matter, and hence it may thrive on such soils, which contain a large amount of nitrogen in a more or less inactive form, without the direct application of nitrogenous fertilizers.

The sweet potato flourishes on a soil rich in vegetable matter, and hence it is usual for truck farmers to apply very large quantities of composted pine needles, woods earth, etc., to the sweet-potato field. By plowing under leguminous plants, as the clovers and cowpeas, a large quantity of nitrogen, obtained by the leguminous crop from the atmosphere, can be economically added to the soil. In an experiment in Delaware crimson clover plowed under in the spring very greatly increased the yield of sweet potatoes.

In most of the experiments on record phosphoric acid has given some increase in the sweet-potato crop, an increase usually sufficient to render profitable the use of phosphoric acid in combination with nitrogen and potash. Its employment alone on sweet potatoes is not generally advisable.

Potash appears to be the most important fertilizer for sweet potatoes. In the great majority of experiments it has been profitably employed, either with nitrogen and phosphoric acid or alone. In nearly all experiments a complete fertilizer—that is, one containing nitrogen, phosphoric acid, and potash—has largely increased the crop and is the safest to use until experience has shown that one of these constituents can be omitted without loss in any given locality.

In deciding on the best form of nitrogen, phosphoric acid, and potash for sweet potatoes we have some help from experiments, but the number of such experiments is as yet too limited to admit of definite conclusions on this point. In New Jersey, in some soils and seasons, nitrogen in the form of nitrate of soda has given larger yields than in the form of dried blood; in other soils and seasons dried blood has proved superior. In Georgia the nitrogen of nitrate of soda gave better immediate results than that of cotton-seed meal and stable manure. Nitrate of soda is more soluble than the other nitrogenous fertilizers, hence acts more quickly, and in a rainy season and on "leachy" soil is more liable to be washed out of the reach of plants. We should expect best results when the sweet potato is supplied with nutrients at all stages of its long season of growth, as, for example, when nitrate of soda and dried blood or cotton-seed meal are applied together, the former to give the plant a good start and one of the latter to become available later in the plant's life. In practice such a mixture has been found advantageous.

Phosphoric acid may be purchased, not only in dissolved boneblack and acid phosphate (superphosphate), but in floats, slag, and in other forms. Both floats and slag contain a larger amount of phosphoric acid than dissolved boneblack and superphosphate, but in a more insoluble form.

The best potash fertilizer for sweet potatoes is probably that in which a pound of potash costs least. Near seaport cities this is ordinarily a low-grade fertilizer, such as kainit; farther inland the cost of trans-

portation may make the concentrated forms, such as muriate and sulphate of potash, relatively cheaper.

Horse manure at the rate of 10 to 20 tons per acre is the chief reliance of market gardeners near large cities for manuring the sweet potato. The New Jersey Experiment Station has shown that commercial fertilizers may be profitably substituted for a part or for the whole of the stable manure when the latter costs about $2 per ton at the farmer's depot. The crops from chemicals were equally as large as from stable manure, and the quality, as indicated by the appearance of the skin, was better. The cost of chemical fertilizers was less than that of a quantity of stable manure sufficient to produce equally large crops. Stable manure has one great advantage over chemical fertilizers in that the effects of the former are apparent for a greater number of years after application. While it is often unwise to purchase stable manure, it is always profitable to use that produced on the farm. It should be well rotted before use on a sweet-potato field.

The following formulas are among those which have given good results at some of the experiment stations:

Fertilizer formulas for sweet potatoes.

Kind and amount of fertilizer per acre.	Nitrogen.	Available phosphoric acid.	Potash.
I.	*Pounds.*	*Pounds.*	*Pounds.*
150 pounds of nitrate of soda 350 pounds superphosphate 150 pounds muriate of potash	24	41	77
II.			
280 pounds dried blood 320 pounds boneblack 160 pounds muriate of potash	29	53	82
III.			
100 pounds nitrate of soda 160 pounds boneblack 80 pounds sulphate of potash 10 tons barnyard manure	*114	†27	113
IV.			
360 pounds cotton-seed meal 320 pounds superphosphate 640 pounds kainit	26	‡43	94

* The manure supplies 98 pounds of nitrogen, the nitrate of soda only 16 pounds.
† In addition to 64 pounds of phosphoric acid in stable manure.
‡ In addition to 11 pounds of phosphoric acid in cotton-seed meal.

These formulas probably supply larger quantities of fertilizers than farmers growing sweet potatoes for home use alone, and on soil already rich, would regard as advantageous. It is believed that to soils poor in nitrogen, phosphoric acid, and potash these formulas will supply the fertilizing ingredients in about the correct proportions. To secure the best results it may often be desirable for the planter to purchase the materials separately and mix them at home, varying the proportions of each ingredient to suit the conditions existing on his own farm.

HARVESTING AND STORING.

The high price of extra early sweet potatoes induces early digging. The first early New Jersey sweet potatoes are usually shipped on or before August 15. Sweet potatoes are palatable as soon as they are large enough for the table, and hence it is not necessary to wait for the maturity of the roots if they are to be used soon after digging. According to the best information attainable, early digging yields only one-half to two-thirds of the crop which would be secured by waiting until nearly time for frost. A New Jersey truck farmer reports a test of this question. On a field set out rather late the weight of roots doubled between the last of August and the middle of October.

For the main crop the farmer can wait until growth is completed, and thus secure the maximum yield. A rule sometimes given for determining ripeness is this: Break several potatoes and expose the pieces to the air for some time. If sufficiently mature to keep well the original color is maintained; if unripe the broken surface assumes a dark or greenish appearance.

Sweet potatoes should be dug only when the ground is dry and before severe frost occurs. Dig in the forenoon, and after several hours' exposure gather the potatoes in baskets or boxes, the latter holding about a bushel each. Before digging the vines are cut and drawn from the row with a sharp hoe; the hand, the hoe, or the plow is used to dig the roots. A light turning plow with rolling coulter run once on each side of the row has been recommended as a means of cutting off a large portion of the vines. The potatoes may be assorted into two or three grades either in the field or at the place where they are to be stored. The greatest care is necessary to prevent bruising the potatoes in handling, for their skins are exceedingly tender, and wounded or bruised roots are almost sure to decay.

There is need for further investigation to determine the best methods of storing sweet potatoes, for the losses occurring during storage are sometimes enormous. In the colder parts of the sweet-potato region, where artificial heat is necessary to prevent freezing, we hear less complaint of rotting during winter than in the States where it is customary to store sweet potatoes in kilns or banks covered with litter and earth.

In Delaware, New Jersey, and some other States tightly built houses are constructed for storing this crop, and by means of a stove these houses are kept quite warm for a week or two after the potatoes are put in, and at 47° to 65° F. during the rest of the winter.

The following extract from a paper by a New Jersey truck farmer, giving his method of storing sweet potatoes, may convey useful information to growers in other localities:

The floor of the storage room should not be tight, and beneath it should be a cellar to contain a coal stove, by which the temperature of

the room may be raised to 100° F. The storage room should have full ventilation at top and sides.

While the potatoes are being stored from the field keep up the heat to the degree named and dry off all moisture as soon as possible. Keep up the heat and ventilation a couple of weeks, when the tubers (if stored in separate crates) will be dry. After this, ventilators may be closed to keep out the cold and the heat may diminish to, say, 60° F. I often let the temperature sink as low as 45°, which will do when outside temperature is cold. But whenever the weather turns warm, and consequently damp, raise the temperature of storage room speedily. The object is to keep the tubers a little warmer than the surrounding air, so that the moisture from this will not condense on the cooler surface of the potato, causing it to "sweat."

A farmer who has had extensive experience with this crop in the northwestern part of Arkansas thus states his method of storing sweet potatoes in a specially constructed cellar:

Divide inside of cellar into slatted stalls 6 feet wide, 3 to 4 feet deep, giving a foot space between stalls. If stalls are one above another, leave 6-inch space between the stalls. For a large cellar 20 or 30 by 50 or 75 feet, leave a 3 or 4 foot hall lengthwise through cellar and build bins on each side of hall. * * * Take sweet potatoes immediately from field to cellar and put in bins 3 or 4 feet deep. If ground is wet, sun awhile so that the dirt will slip from the potatoes. * * * Put nothing around, over, or under them. Leave free to air. * * * Every night or day that the thermometer registers 40° above zero, but mostly at night, if possible, keep all ventilators wide open; but should it get above 65° outside, close all ventilators tight, for if you let hot air in your cellar it will condense or cause potatoes to get wet (sweat). * * * Keep as near 45° or 60° inside as possible. But be sure never to have any part of this cellar stand open when the air outside is 15° warmer than inside. This hot air not being allowed to strike the cool potatoes or walls and condensing is the whole secret in keeping them. Cool or cold air will go all through them and drive out all the moisture, but hot air will not.

Sweet-potato houses can be made above ground as well as below, by using one or more layers of building paper under the siding and ceiling.

From Virginia southward the usual method of keeping sweet potatoes is to store them under an open shelter in cone-shaped banks, covered with 4 to 8 inches of straw, hay, or pine needles, and a similar thickness of earth on top of that. A ventilator, made of three or four narrow boards perforated with auger holes, should be provided. A few cornstalks laid on the potatoes beneath the covering of litter and extending from the straw floor of the bank to the point of the cone, and also on the raised ground below the litter on which the cone is built, improve the ventilation and reduce the moisture within the bank. In fair weather the dirt covering may be omitted for a few days, and the ventilator, protected from rain, should remain open except during cold weather. In the South sweet-potato houses are also made of logs daubed with clay.

Small quantities may be kept for a few months by packing in dry sand and placing in a dry cellar or room. In the South the writer found that sweet potatoes stored several days after digging in large baskets or boxes lined and covered with several thicknesses of newspapers keep fairly well for a short time. In experiments at the South Carolina Experiment Station he found cotton-seed hulls to be a packing material superior to cotton seed, so often used for this purpose. Dry sand was found useful as a covering for sweet potatoes, but less convenient and satisfactory than cotton-seed hulls.

To sum up, sweet potatoes during storage should be kept in a dry atmosphere, with ample ventilation, and a temperature between 50° and 65° F., except during the sweating period, for which time the temperature recommended by those who use artificial heat is about 80° F.

VARIETIES.

As the sweet potato is not often propagated by seed, there are comparatively few true varieties. Yet about one hundred names, many of them purely local, have been met with in the preparation of this bulletin. The multitude of local names greatly confuses the study of varieties.

The little word "yam" seems to be responsible for considerable confusion in the nomenclature of varieties. Its application is very loose, a variety which in one locality is called a sweet potato being in another designated a yam. There are so-called yams with skins white, yellow, or red, and with flesh either soft and sirupy or dry and starchy. A further objection to the indiscriminate use of the word yam is the fact that it is the correct common name of the *Dioscorea* family of plants, none of which are cultivated in this country except as rare or ornamental plants.

In general terms it may be said that the favorite table varieties are not among the most productive. In variety tests at experiment stations the following varieties gave the largest yields: Providence, at Baton Rouge, La., in 1893; Hayman, at Baton Rouge, La., in 1892, and Raleigh, N. C., in 1890; Pumpkin Yam, at Experiment, Ga., and Baton Rouge, La., in 1891; Peabody, at Calhoun, La., in 1892; Shanghai, at College Station, Tex., in 1892; Providential, at Geneva, N. Y., in 1890; Red Bermuda, at Lincoln, Nebr., in 1889; and Early Golden, at Stillwater, Okla., in 1892. As instances of extremely large yields, may be cited the 13 most productive varieties tested at Baton Rouge, La., in 1893, of which the yields in bushels per acre were as follows:

Providence	1,072	Georgia	580
Shanghai	758	Ticotia	568
Red Nansemond	717	Southern Red Yam	555
Peabody	696	Barbados	531
Norton	654	Negro Choker	534
Hayman	651	Spanish Yam	520
Southern Queen	640		

These are maximum figures, but they emphasize the difference in the productiveness of varieties, for in this same experiment were varieties yielding less than 200 bushels per acre.

Generally the Southern consumer prefers a sugary sweet potato; the Northern markets demand a starchy root, which, when cooked, will be rather dry. Sugar Yam, Yellow Yam, Spanish Yam, Barbados, Georgia Yam, Hayman, Vineless, and Pumpkin Yam are among the favorite table varities in the Southern States. The Yellow Nansemond and the Jersey are standard varieties in Northern markets. Other varieties which have been recommended for shipping to Northern cities are Early Carolina, Red Nansemond, and Red Nose. Among the well-known early varieties are Early Carolina, Strasburg, Southern Queen, and Vineless.

Among the most productive varieties, and hence most suitable for growing as food for live stock, are Providence, Hayman, Norton, Peabody, Red Bermuda, Shanghai, Southern Queen, Negro Choker, and Pumpkin Yam.

Among varieties which keep well are Hayman and Southern Queen.

The variety most easily cultivated is Vineless.

FUNGOUS DISEASES.

A considerable proportion of the sweet-potato crop is destroyed by fungous diseases.

Black rot (*Ceratocystis fimbriata*).—This is regarded as the most destructive disease of the sweet potato, and is widely spread. It appears on the root in the form of dark olive brown or green patches, which may not be noticed at harvesting, but which enlarge during storage. These patches are sunken areas, resembling spots burned into the potato with a metal die. The flesh becomes black and bitter, and the diseased root is a source of contamination. Black rot, unlike soft rot, is a dry and inoffensive decay. A second form of the disease attacks the young sprouts growing in the propagating bed, and this "black shank" here consists of lines and spots colored as stated above. The disease renders the young plants worthless and even accomplishes their death by girdling. (See fig. 2.)

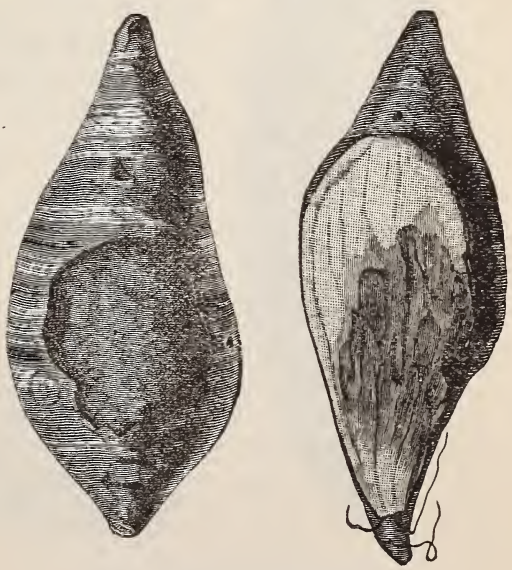

FIG. 2.—Black rot of sweet potato.

If a potato with black rot, however slight, is used in the plant bed,

the following spring the sets which grow from it will generally be diseased and will cause the potatoes produced by them to be again infected. Another danger is that the earth or manure of the hotbed or field may be contaminated. It is not regarded as safe to put diseased roots in the manure heap or in the feed of stock if the manure is to be used on sweet potatoes. The field on which diseased sweet potatoes have been grown will probably remain unfit for this crop for several years. Decaying roots should not be left on the soil, but should be collected and burned; it is well also to burn the diseased vines. It is believed that the germs of this disease may be conveyed by the wind.

The fear of getting disease germs in the propagating bed is the consideration that causes some large growers to avoid garden earth or rich cultivated soil in the plant bed, and to use instead fertilized sand or woods earth, which are naturally less apt to be infected. The Delaware Experiment Station deems it practicable to heat to high temperature the soil of a hotbed warmed by flues so as to destroy the germs of black rot.

To be sure that no plants affected with "black shank" are set out, one grower goes so far as to lift and examine for black rot every seed potato before its sprouts are utilized, rejecting sprouts from diseased roots. Thus he gets only one crop of sprouts, but he regards this course as profitable.

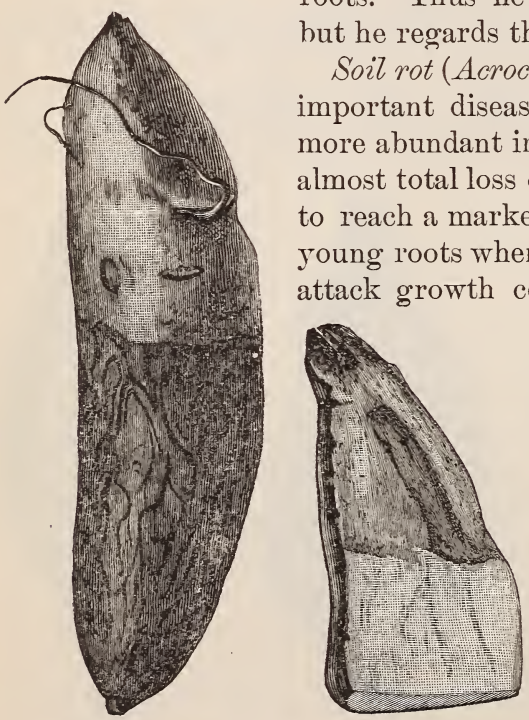

FIG. 3.—Soft rot of sweet potato.

Soil rot (*Acrocystis batatas*) is one of the most important diseases of the sweet potato. It is more abundant in a dry year, sometimes causing almost total loss of the crop, the potatoes failing to reach a marketable size. Soil rot attacks the young roots when quite small. At the points of attack growth ceases and constrictions result. After the maturity of the root this disease "does not work on and destroy the root, but the potatoes, if large enough, can be shipped to market."

Soil rot has not been observed to spread by way of the hotbed, but only through contamination of the soil of the field. It is believed that the spores of this fungus, which correspond to the seed of higher plants, may be blown like dust from an infected field to one formerly free from the disease. No remedy is known, but rotation of crops is a preventive measure, the sweet potato occupying the land only once every four or five years.

Soft rot (*Rhizopus nigricans*) is a soft and putrid decay of the stored roots. (See fig. 3.) Soft rot may not appear on roots when dug; it is most abundant a few weeks after harvesting, being most liable to occur in the sweating period, when moisture is accumulated on the surface of the roots. The rational preventive treatment for soft rot is to burn all diseased potatoes, and dry the good potatoes for a few days after digging by placing them in a well ventilated and artificially warmed room, with a temperature of 70° to 80° F. Avoid bruising or wounding roots in handling. It is important to remove from the pile all rotted potatoes, for the disease can be rapidly communicated from root to root during storage. At the Louisiana Experiment Station dusting the stored roots with *fostite* (copper sulphate and soapstone powder) checked the progress of this rot.

Dry rot (*Phoma batatæ*).—In dry rot the whole upper part of the potato becomes dry, wrinkled, and pimply, and the entire substance of the potato is diseased, being reduced to an almost powdery condition. Such diseased potatoes should be burned.

White rot.—The diseased portions of the root have an almost chalky color and consistency. The first evidence of this disease is a slight depression in the root at the base of a hair-like rootlet.

Sweet-potato scurf (*Monilochætes infuscans*) is a brown and rusty coating, frequently appearing on the roots. It causes shrinking, by which the market value of sweet potatoes is reduced, but it does not result in decay. It continues to spread on the root after harvesting. As a precautionary measure, roots free from scurf should be used in the propagating bed.

Stem rot.—The vine while young turns yellow, then black near the ground, and dies at or near the surface of the ground; but, if rooted at some joint, it remains green beyond that point. The rot also attacks the upper part of the root, which, detached from the vines, sends up new shoots late in the season. "The germs are in the soil and inoculation is direct. It is not, therefore, so much a question of healthy plants as a 'healthy soil,' if such an expression is allowable."

Two diseases of the sweet-potato leaf have been described—the leaf blight (*Phyllosticta batatícola*) and the white leaf scab (*Albugo ipomœæ-panduranæ*). The leaf-blight fungus produces white, dead patches on the leaf. The white leaf scab is shown by brown patches on the upper side of the leaf and whitish, scab-like spots opposite the brown patches on the underside. As the disease progresses the brown spots become dark, and the whitish scabs fade out to yellow. The fungus causing this disease grows upon the wild sweet potato or the wild morning glory, sometimes called man-of-the-earth, a weed with massive roots. This weed harbors the fungus during the winter in gall-like enlargements of the leaf stem, which, breaking up in the spring, become centers of infection; hence, this weed should be destroyed.

The following are the most important insects attacking the sweet potato:

Cutworms.—It is very desirable to rid the field of cutworms before setting the plants. When danger from this source is apprehended clean culture late in the preceding year should be adopted, and in the spring the field should be plowed early and no green growth should be allowed to appear on the land. A few days before the time for setting the sweet-potato plants thoroughly spray a patch of weeds, grass, or clover with 1 pound of paris green or London purple in 100 gallons of water. Cut the sprayed plat close, and place small heaps of the poisoned food through the field at intervals of 15 to 20 feet each way. Such worms as are present in the field will eat this poisoned vegetation and will thus be destroyed.

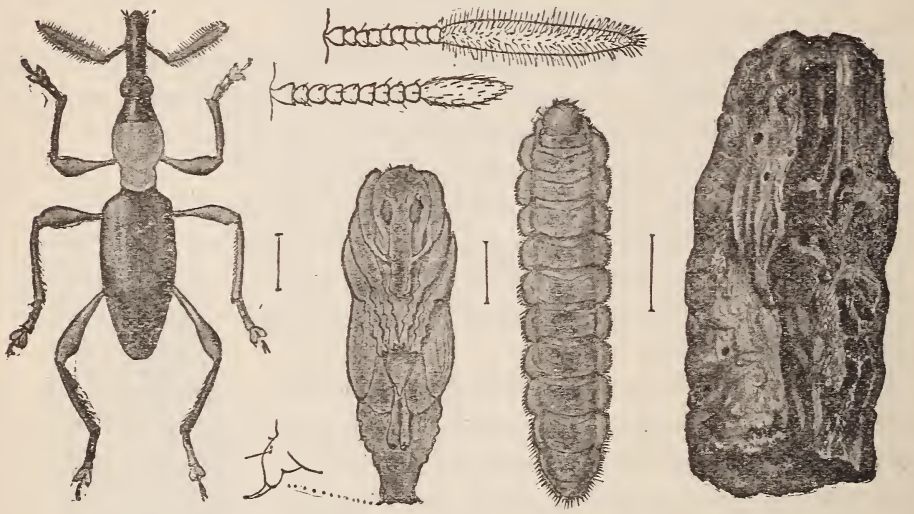

FIG. 4.—The sweet-potato root borer (*Cylas formicarius*). Extreme left-hand figure, adult beetle with enlarged antennæ at right and above. Figure at left center, pupa; at right center, larva; at extreme right, portion of sweet-potato tuber channeled by borer. All figures except the last considerably enlarged; natural sizes indicated by hair lines. (Drawn by L. Sullivan.)

Flea-beetles.—These tiny insects are most injurious to the sweet potato soon after the plants are set in the field. The New Jersey Experiment Station recommends that the sets as soon as drawn be dipped into water in which 1 pound of paris green or London purple and 1 pound of lime have been mixed in every 175 gallons of water, or in a decoction of tobacco. This is expected to protect the young plants until they have started growth, after which they can better withstand insect attacks.

Tortoise beetles (*Cassidæ*).—These "golden bugs," both in the form of beetles and in their larval state as spiny worms, eat the leaves of the young sweet-potato plant. Spraying as soon as the plants are well rooted and again a week later with 1 pound of paris green or London purple and 1 pound of lime to 175 gallons of water is recommended.

Sweet-potato sawflies (*Schizocerus* spp.).—Should the larvæ of sawflies become troublesome on sweet-potato vines, spraying with the formula given in paragraph on flea-beetles should be tried.

Sweet-potato root beetle (*Cylas formicarius*).—This subtropical insect has honeycombed sweet-potato roots in some parts of Florida, Louisiana, and Texas. It is the most serious enemy to the sweet-potato crop in regions where it occurs and seems to be extending its range northward. Pulling up and burning all affected roots and vines is the only means at present known for repressing this pest. Sweet-potato growers in regions which this insect has not reached should be on the lookout for it and should especially examine with great care all sweet potatoes brought from Florida, Texas, or Louisiana. The accompanying illustration (fig. 4), drawn under the supervision of the Entomologist of this Department, is introduced to familiarize growers with its appearance. The infested tubers become thoroughly channeled with the larval burrows, and eventually shrivel up and decay. The colors of the beetle are red and black.

Sweet-potato hawk moth (*Macrosila cingulata*).—The larva of this insect is known to growers as the "horn worm." Its large size renders it easy to hand pick, and it is also readily destroyed by the paris-green treatment.

USES OF SWEET POTATOES.

AS A TABLE VEGETABLE.

The most important use of the sweet potato is as human food, the roots being baked, boiled, or otherwise prepared. It contains more dry matter and more starchy and sugary material, but less nitrogenous nutrients than the Irish potato. A dietary in which it enters largely should also include beans, peas, lean meat, eggs, or other highly nitrogenous food.

Uncooked sweet potatoes may be sliced and then dried either in the sun or in evaporators. They are prepared for the table by soaking and baking. Dried sweet potatoes were exhibited among the products of Japan at the Columbian Exposition. Their preparation is described as follows:

"Cleanly washed potatoes are placed in a suitable basket and immersed in boiling water for a short time; when taken out of the basket they are cut into thin slices and spread over mats and exposed to the sun for two or three days. In order to make a superior quality the skin of the potato is peeled off before slicing."

In some countries the young leaves and tender sprouts of the sweet-potato plant are prepared and eaten like spinach.

CANNING SWEET POTATOES.

Within recent years sweet potatoes have been canned in a few localities. In 1893 a factory in Mississippi canned about 1,000 bushels, using

3-pound cans, which sold in Chicago at 95 cents per dozen delivered. A bushel of sweet potatoes was sufficient for 15 cans. Farmers were paid 40 cents per bushel. This firm expected to can about 8,000 bushels of sweet potatoes in 1894.

Should the canneries now engaged in packing sweet potatoes succeed in creating a large demand for this product, sweet potatoes would become a profitable cash crop in many localities where they are now unsalable. The canneries would also be benefited, not only in the direct profits from canning sweet potatoes, but in being able to operate during a greater number of months, the sweet-potato crop coming in after most vegetables and fruits have passed out of season.

SWEET POTATOES AS FOOD FOR STOCK.

Only in localities favored with transportation facilities and good markets is the sweet potato a sale crop. But as a food for stock it should be extensively grown in regions adapted to it. The roots have been successfully fed to hogs, cattle, and horses. For cattle and horses it is better to slice the roots. Of all classes of stock, hogs can be used to consume sweet potatoes to best advantage, since they do their own digging.

The following table gives the average composition of 7 varieties of sweet potatoes, the figures for each variety having been compiled from analyses of roots grown in three or four States.

Average composition of varieties of sweet potatoes.

Variety.	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Total dry matter.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Jersey (including Early Jersey, New Jersey, and Yellow Jersey)	69.52	1.09	2.28	1.23	24.59	0.63	29.82
Peabody (including Early Peabody)	73.11	1.11	1.81	1.22	22.73	.59	27.46
Pumpkin	70.09	1.18	1.94	1.22	24.06	.66	29.06
Red Bermuda	72.30	1.11	1.77	.86	23.24	.55	27.53
Southern Queen	67.17	1.11	1.38	1.11	28.46	.43	32.49
Shanghai	69.32	1.29	1.88	.99	25.75	.77	30.68
Vineless (including Bunch Yam and Early Bunch Yam)	70.24	1.10	2.47	1.05	24.29	.85	29.76

We find from the above table that 100 pounds of sweet-potato roots contain 69.32 to 73.11 pounds of water, 1.09 to 1.29 pounds of ash, 1.38 to 2.47 pounds of protein (the so-called flesh formers, the most costly of all food constituents), 0.86 to 1.23 pounds of fiber, 22.73 to 28.46 pounds of nitrogen-free extract (starch, sugar, gums, etc.), and 0.43 to 0.85 pounds of fat, or a total of 27.46 to 32.49 pounds of dry matter. If we judged of food value by the amount of dry matter we should pronounce Southern Queen the most nutritious variety, but its advantage in dry matter is counterbalanced by its low content of protein, only 1.38 per cent. This variety especially, and indeed all sweet potatoes, are too

deficient in protein to constitute a perfect food when used alone. This deficiency may be supplied by feeding, in connection with sweet-potato roots, foods rich in protein, such as clover, peas, cotton-seed meal, middlings, and skim milk. Since the differences in the nutritive value of the above varieties are not great, the choice of varieties for stock food may be based on productiveness alone (see p. 20).

A clear conception of the food value of sweet potatoes may be acquired by comparing the composition of these roots with that of corn.

Relative food values of corn and sweet potatoes.

	Dry matter.	Protein.	Nitrogen-free extract and fat.
	Pounds.	*Pounds.*	*Pounds.*
100 pounds corn contain	89.1	10.5	75
300 pounds sweet potatoes contain	86.7	4.5	75.3

Thus 3 pounds of sweet potatoes afford almost as much dry matter, quite as much carbonaceous material, but less than half as much protein as is contained in 1 pound of corn. By using one-half pound of cotton-seed meal or 1 pound of cowpeas (seed) for every 10 pounds of sweet potatoes this deficiency in protein is fully supplied. I can find no record of digestion experiments with sweet potatoes.

On many an acre of rather poor, sandy land where corn is now grown it would be advantageous to substitute sweet potatoes intended for stock food, for frequently such soils are capable of producing 5 to 8 times as much sweet potatoes as corn.

THE VINES AS FOOD FOR STOCK.

Sweet-potato vines are usually left to decay in the field where they are grown. However, they may be utilized as food for cattle. An analysis of very succulent sweet-potato vines grown in Texas showed them to be practically identical in chemical composition with succulent cowpea vines, of which the feeding value is well established.

Vines of 5 varieties were analyzed at the Georgia Station, and showed considerable differences in composition. It is claimed that the vines of the so-called Vineless variety, which stand up well, can be cut with a mowing machine, but to permit of this it will be necessary to cultivate nearly level. The vines are better suited for feeding green than for curing into hay. In the silo they are said to become slimy. The writer weighed a heavy crop of green vines, and found that the weight was $5\frac{1}{6}$ tons per acre. At the Texas Experiment Station the yield of green vines was much greater.

COST OF PRODUCTION.

Sweet-potato growers in a number of States furnished the data used below in estimating the cost of growing sweet potatoes. Rent, cost

of fertilizers, and cost of shipping are not included in the following statements.

Averaging the returns of several experienced growers in New Jersey, we have the following figures, which may be taken as representative of the cost (less fertilizers and rent) of growing an acre of sweet potatoes in New Jersey, Delaware, and the tide-water counties of Virginia: Sets grown or purchased, $5; preparation of the soil, $1.97; transplanting (with wooden tongs), $2.12; horse cultivation, $1.62; hoeing and other hand work, $3.75; harvesting, $6.50; total, $20.96. To this, in addition to rent or interest, must be added $10 to $40 per acre for fertilizers or stable manure.

The following figures are averages from six statements selected from among those sent in by growers in the Southern States, and give the cost of cultivating an acre: Seed potatoes for sets or vine cuttings, $1.98; preparation of the soil, $2.79; transplanting sets or cuttings, $2.91; horse cultivation, $1.87; hoeing and other hand work, $1.62; harvesting, $5.66; total, $16.83. The figures used in making up these averages vary between the following limits: Seed potatoes, $1.25 to $4.75; preparation of land, $1.25 to $4.50; transplanting, $1 (doubtless for vine cuttings) to $6; horse cultivation, $1 to $3; hoeing, etc., 50 cents to $3.50, and harvesting, $3 to $8.

Numerous other estimates of the cost of growing an acre of sweet potatoes in the Southern States approximate closely to $16.83, and confirm the correctness of this figure. Returns from this section of the country indicate that this crop is too frequently left without manuring.

As regards cost per bushel, an Arkansas horticulturist, who grows sweet potatoes on a large scale, places the cost of a bushel of sweet potatoes in the ground at 4½ to 11½ cents when the yield is 150 to 300 bushels per acre; digging and storing cost him 2½ to 3½ cents, making a total cost of 7 to 15 cents per bushel in the cellar. From Illinois and from Georgia come statements that 20 cents is the cost of growing and harvesting a bushel.

When we come to consider selling price and profits we find difficulty in generalizing, on account of the wide fluctuations to which the price of this vegetable is subject in the large cities, and to the fact that over a great extent of country there is practically no market, except for small quantities.

The principal markets for Eastern growers are New York, Baltimore, Philadelphia, Boston, and Providence, and in spite of wide fluctuations in price the sweet-potato crop is usually profitable in localities favored with cheap transportation facilities to these cities. During the period from July 15 to August 15 there is only a limited supply of sweet potatoes in Northern markets, and potatoes of good quality find a ready sale at relatively high prices. The sweet potato is a profitable crop where local sales can be effected. In localities remote from mar-

kets the profit in growing this crop on a large scale must come from converting sweet potatoes into pork or some other valuable animal product. As a partial substitute for corn in the food of hogs the sweet potato should be extensively used in localities where, on account of poor, sandy soil, corn does not give large yields.

SUMMARY.

The sweet potato is most commonly propagated by means of the buds or shoots from the roots, which are called sets. The roots are planted in hotbeds and the sets which develop are removed and transplanted in the field. This crop is sometimes grown from vine cuttings.

For lightening the labor of transplanting sweet-potato sets, wooden tongs, or transplanters drawn by horses, may be used.

In experiments at the Alabama Station cuttings gave a slightly larger yield than sets; at the Louisiana Station sets produced the larger crop. In Louisiana vine cuttings 16 to 24 inches long gave larger yields than shorter cuttings. It is generally regarded as unprofitable to move sweet-potato vines after last cultivation.

One hundred and eighty-five bushels (10,000 pounds) of sweet potato roots remove from the soil 23 pounds of nitrogen, 10 pounds of phosphoric acid, and 50 pounds of potash; this is equal to the nitrogen in about 150 pounds of nitrate of soda, to the phosphoric acid in about 90 pounds of acid phosphate (superphosphate), and to the potash in about 370 pounds of kainit.

A fertilizer containing nitrogen, phosphoric acid, and potash is most certain to afford a large yield. Of these constituents potash is most important and should be supplied in largest quantity.

Much confusion exists in the names applied to varieties of sweet potatoes. Generally the Southern consumer prefers a sugary sweet potato, such as Sugar Yam, Yellow Yam, and Barbados. Northern markets demand a starchy, rather dry root, such as Big Stem Jersey and Nansemond. As food for live stock the most productive varieties should be grown, as Providence, Shanghai, Hayman, Red Bermuda, and Southern Queen.

Early digging of sweet potatoes considerably reduces the yield, but is sometimes justifiable by reason of the higher prices prevailing earlier in the season.

Sweet potatoes are more easily brusied than mature Irish potatoes and require very careful handling.

Sweet potatoes are successfully kept by maintaining a temperature of about 75° F. for a week or two after digging, then lowering the temperature and keeping it through the winter at 50° to 60° F. The atmosphere of the storage room should be kept dry. The condensation of moisture on the roots affords conditions favorable to decay.

The use of sound seed sweet potatoes and rotation of crops are the best means of avoiding fungous diseases and insects, which sometimes seriously injure the sweet-potato crop.

A little over two-thirds of the weight of sweet-potato roots is water. Three pounds of sweet potatoe afford as much dry matter, but less than half as much protein (the so-called flesh formers), as 1 pound of corn. Sweet potatoes on sandy soil generally yield more dry matter (food) per acre than corn, and in many cases may be advantageously substituted for this crop on land too sandy and poor to afford a profitable yield of corn, and may be used as a food for hogs and other live stock.

The cost (exclusive of rent and fertilizers) of growing and harvesting an acre of sweet potatoes varies greatly, and is estimated to be, on an average, not far from $20. In spite of wide fluctuations in price, the sweet-potato crop is usually profitable in localities favored with cheap transportation facilities to large cities. It is also a profitable crop where local sales can be effected. In localities remote from markets the profit in growing this crop on a large scale must come from converting sweet potatoes into pork or some other valuable animal product.